TECHSAVIATION
Training Center

Este material em hipótese alguma substituirá os manuais do fabricante para qualquer ação de manutenção. Consulte os manuais correspondentes. **EDUCATIONAL PURPOSE ONLY**

POWER PLANT

Power Plant

Engine Characteristics

The GEnx-1B is a high-bypass ratio, two-spool turbofan engine. The bypass ratio is approximately 9:1.

The GEnx-1B has these takeoff thrust ratings:

- 787-8: 70,000lb
- 787-9: 74,000lb
- 787-10: 76,000lb.

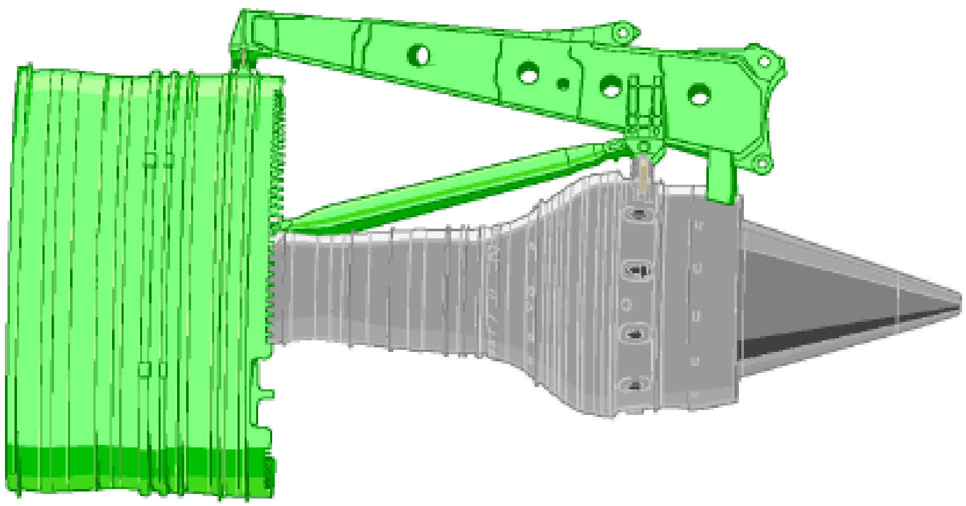
Fixed and hinged cowls are the parts of the engine nacelle. The cowls permit smooth airflow through and around the engine.

The fixed cowls include the inlet cowl and exhaust plug.

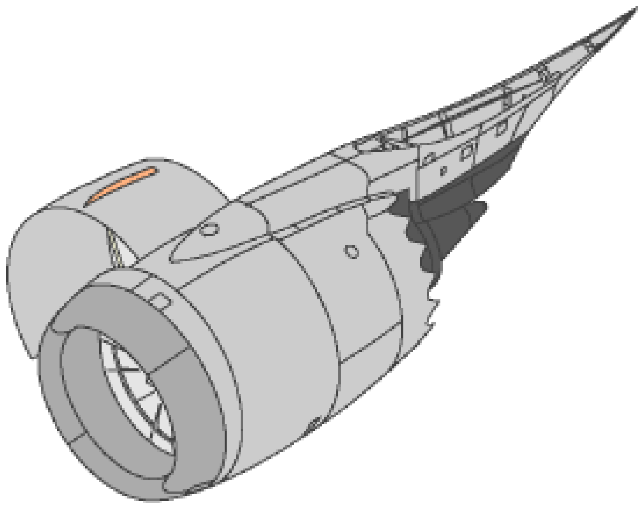
Hinged cowls include the fan cowl and Thrust Reverser (T/R) assembly. They have hinges on the strut and latches on the bottom.

Most of the engine Line Replaceable Units (LRU) are on the core of the engine and the T/R cowls must be opened to gain access to these LRUs.

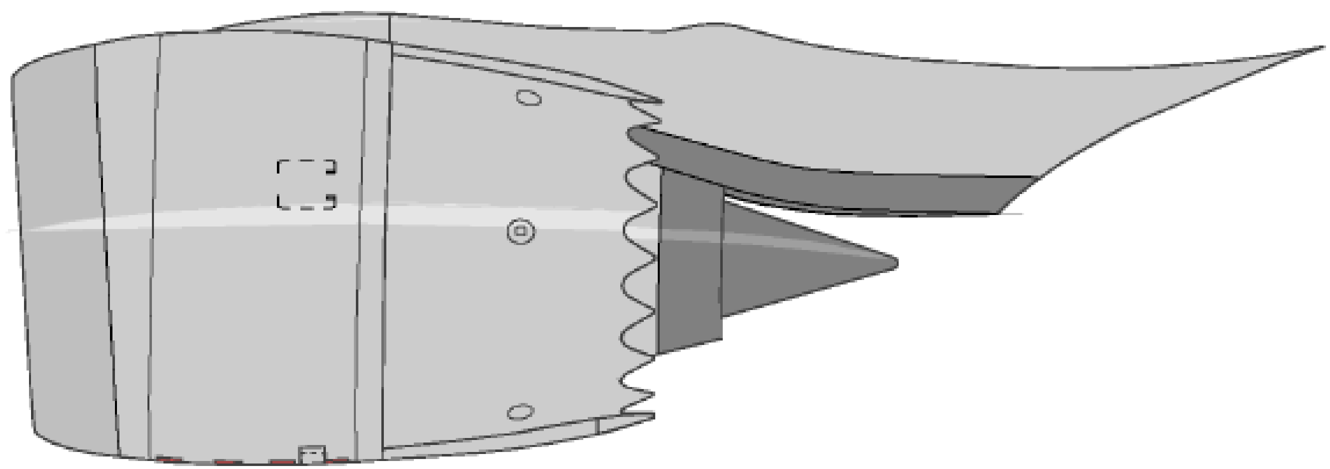
The fan cowls and thrust reverser assemblies open hydraulically with the Power Door Opening System (PDOS).



Engine Mounts



Left Engine
(Right Engine Opposite)

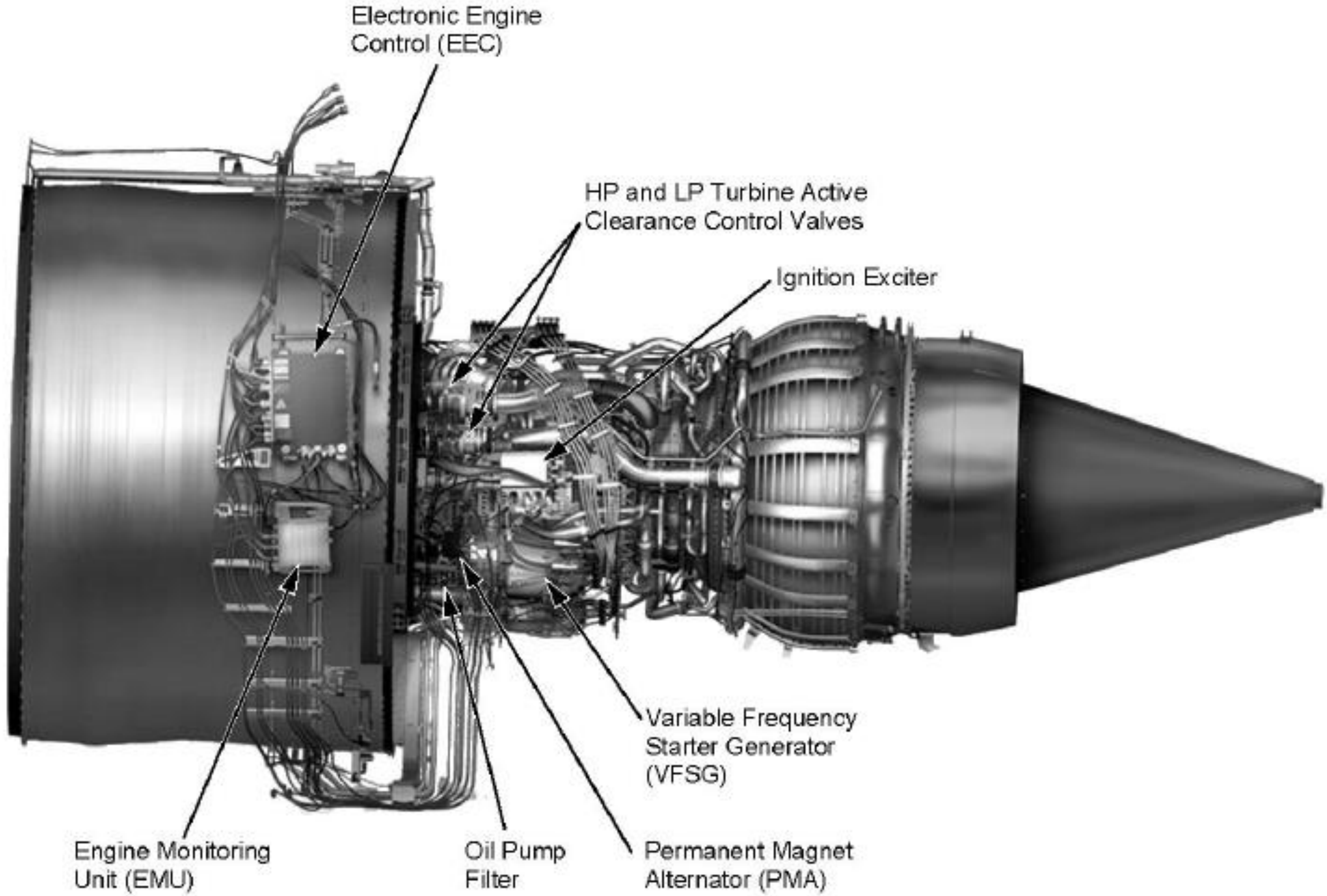


Cowlings

Engine Component Location-Left Side

The engine has these components on the left side:

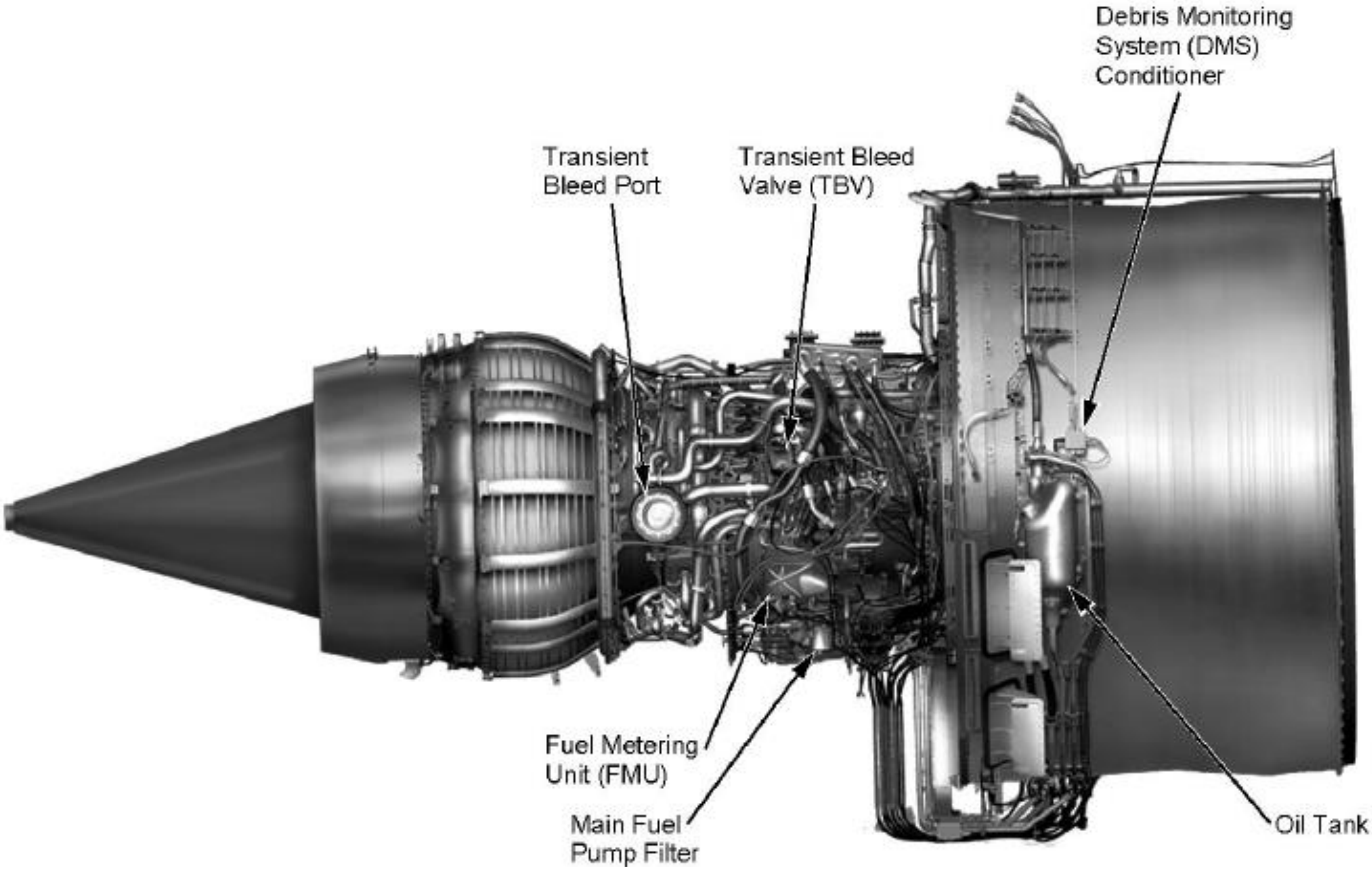
- Electronic Engine Control (EEC)
- Ignition exciter
- Permanent Magnet Alternator (PMA)
- Oil pump filter
- Variable Frequency Starter Generator (VFSG)
- High Pressure Turbine Active Clearance Control (HPTACC) valve
- Low Pressure Turbine Active Clearance Control (LPTACC) valve
- Engine Monitor Unit (EMU)


Electronic Engine Control (EEC)
HP and LP Turbine Active Clearance Control Valves
Ignition Exciter
Variable Frequency Starter Generator (VFSG)
Engine Monitoring Unit (EMU)
Oil Pump Filter
Permanent Magnet Alternator (PMA)

Engine Component Location-Right Side

The engine has these components on the right side:

- Fuel Metering Unit (FMU)
- Transient bleed port
- Main fuel pump filter
- Transient Bleed Valve (TBV)
- Oil tank
- Debris Monitoring System (DMS) conditioner


Debris Monitoring
System (DMS)
Conditioner
Transient
Bleed Port
Transient Bleed
Valve (TBV)
Fuel Metering
Unit (FMU)
Main Fuel
Pump Filter
Oil Tank

Power Door Opening System

The Power Door Opening System (PDOS) is used to open the engine fan and Thrust Reverser (T/R) cowls. It uses gravity to close the cowls.

The PDOS has these components:

- One power pack
- Two fan cowl control switches
- Two fan cowl hydraulic actuators
- Two T/R control switches
- Two T/R hydraulic actuators.

The power pack supplies hydraulic power to the cowl actuators. It has a reservoir and an electric motor pump. The PDOS is serviced with engine oil.

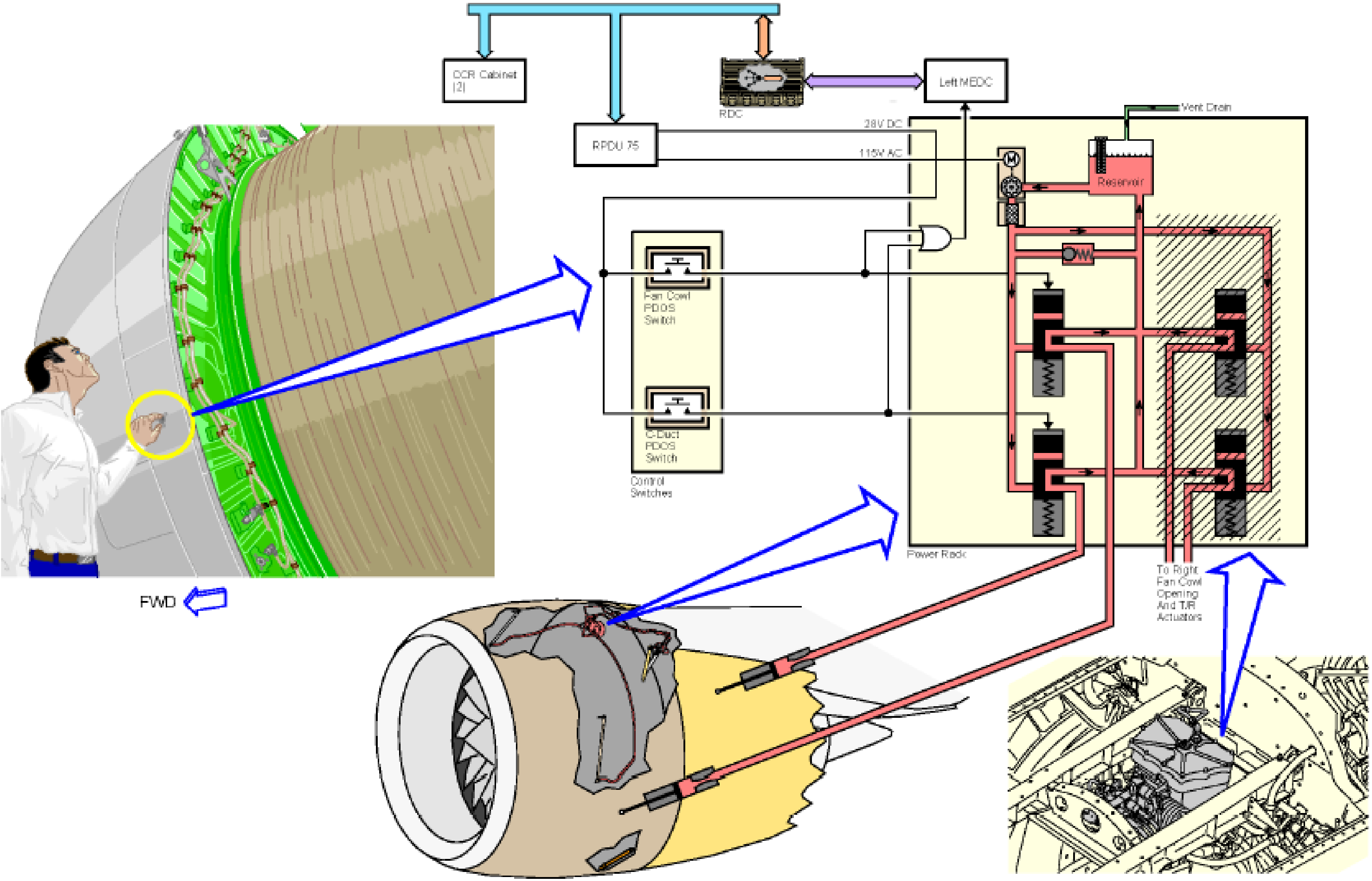
A Remote Power Distribution Unit (RPDU) supplies 28V DC power to the solenoids in the power pack and the control switches.

When one of the control switches is pushed and held, current is sensed by the Main Engine Data Concentrator (MEDC). The MEDC sends this signal through the Common Data Network (CDN) to the Common Core System (CCS).

The CCS commands the RPDU to supply 115V AC power to operate the electric motor pump to supply hydraulic power to the specific actuator.

The actuators have an internal lock when fully extended, but care should be taken when opening and closing the engine cowls.

The cowls may be opened manually using a hand pump if necessary.


CCR Cabinet (2)
RDC
Left MEDC
RPDU 75
28V DC
115V AC
Vent Drain
Reservoir
Fan Cowl PDOS Switch
C-Duct PDOS Switch
Control Switches
Power Rack
To Right Fan Cowl Opening And T/R Actuators
FWD

Engine-General Description

The Low Pressure (LP) shaft (N1) has these components:

- Fan section comprising eighteen 111 inch (2.8 meter) fan blades
- Four-stage Low Pressure Compressor (LPC)
- Seven-stage Low Pressure Turbine (LPT).

The fan supplies approximately 80 percent of the thrust during takeoff.

The High Pressure (HP) shaft (N2) turns the external accessory gearbox and has these components:

- Ten-stage High Pressure Compressor (HPC)
- Two-stage High Pressure Turbine (HPT).

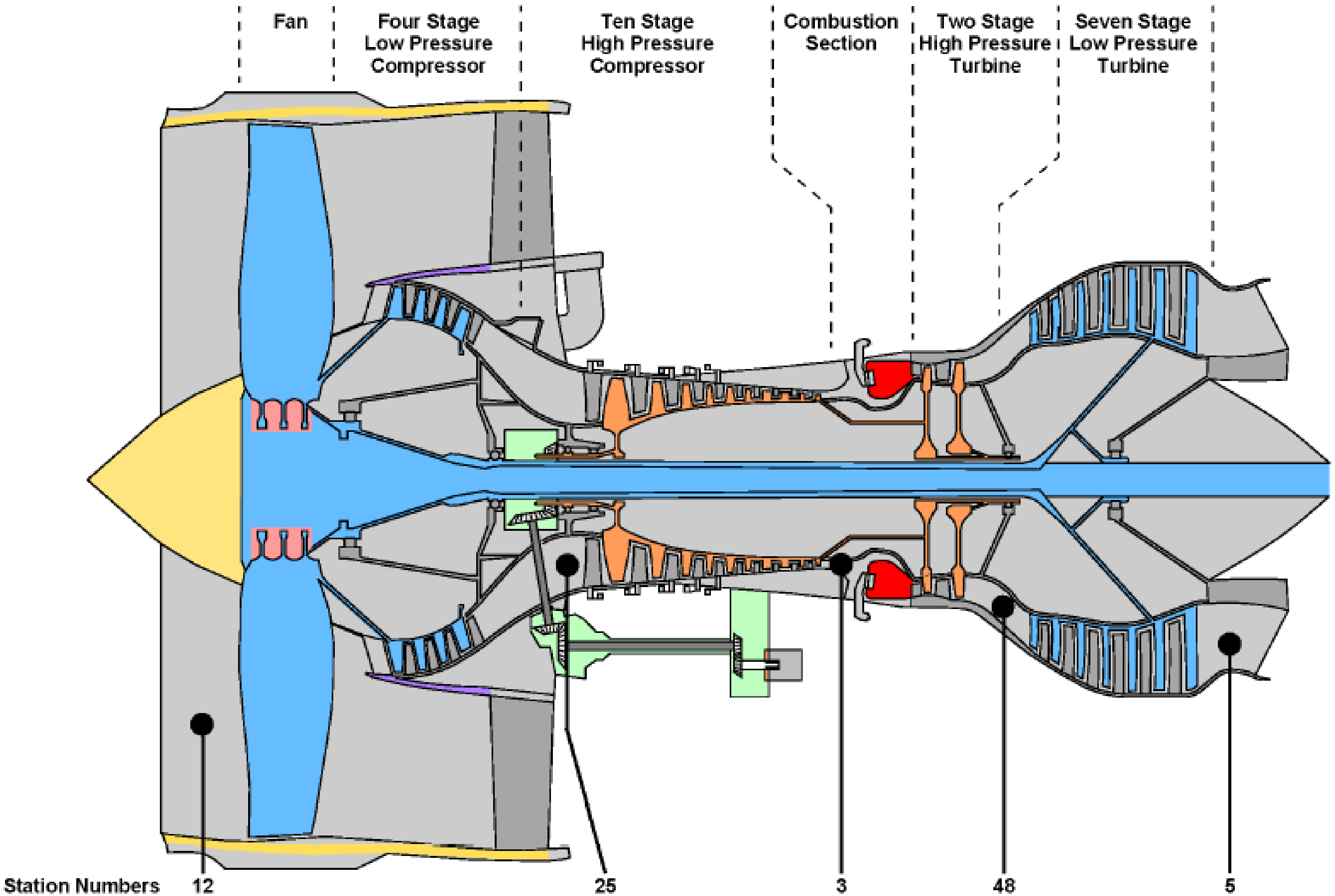
The HPC increases the pressure of the air from the LPC and sends it to the combustor.

The combustor mixes air from the compressors and fuel from the fuel nozzles. This mixture burns in the combustor to produce hot gases. The hot gases go to the HPT.

The HPT converts the energy of the hot gases into mechanical energy. The HPT turns the HP shaft.

The LPT turns the LP shaft and the fan.

The engine has station numbers to identify locations along its axis.


Fan
Four Stage Low Pressure Compressor
Ten Stage High Pressure Compressor
Combustion Section
Two Stage High Pressure Turbine
Seven Stage Low Pressure Turbine
Station Numbers
12
25
3
48
5

Engine Control System

The main component in the engine control system is the Thrust Control Module (TCM).

The TCM has these components:

- Thrust Levers (TL)
- Thrust Lever Angle (TLA) resolvers
- Autothrottle servo control motors
- Fuel Control Module (FCM)
- Thrust reverser lockout solenoid
- Autothrottle disengage switches
- Takeoff/Go-around (TOGA) switches.

The TLs are mechanically linked to the TLA resolvers. Each TL has two TLA resolvers that convert the throttle position into an electrical signal.

When a TL moves, the corresponding TLA resolver moves and sends a Thrust Resolver Angle (TRA) position signal to both the EEC channels.

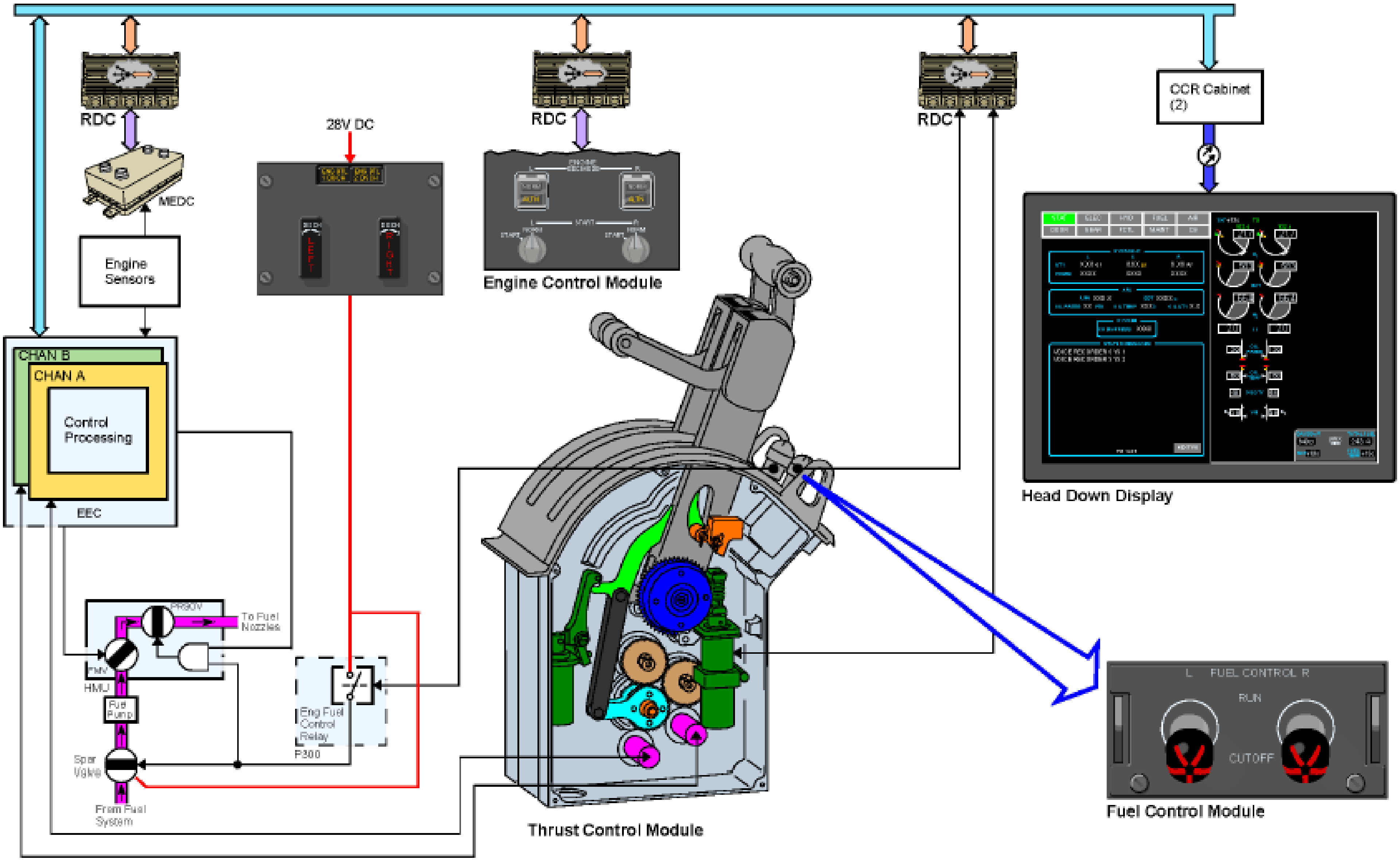
The FCM sends fuel switch position data to the EECs and the Common Core System (CCS) through the Common Data Network (CDN).

The EEC uses these signals to initiate engine start. The CCS uses the signals for EICAS displays and messages.

The fuel switches also control the fuel control relays in the P300 and P400 panels. These relays open and close the engine fuel spar valves.

In the event of an engine fire, the fire switches supply 28V DC power directly to the spar valve to close it.

The engines can also be controlled by the Thrust Management Function (TMF) using the Autothrottle Servo Motors (ASM).


RDC
RDC
RDC
CCR Cabinet (2)
28V DC
MEDC
Engine Sensors
Engine Control Module
Head Down Display
CHAN B
CHAN A
Control Processing
EEC
PRSOV
To Fuel Nozzles
FMV
HMU
Fuel Pump
Spar Valve
From Fuel System
Eng Fuel Control Relay
P300
Thrust Control Module
FUEL CONTROL
RUN
CUTOFF
Fuel Control Module

Electronic Engine Control

The Full Authority Digital Electronic Control (FADEC) system controls these engine functions:

- Thrust management
- Engine systems control
- Engine fault monitoring
- Engine communication with other airplane systems.

The heart of the system is the Electronic Engine Control (EEC). The EEC is a two-channel digital electronic control. Each channel receives the necessary control inputs and can control the engine.

The EEC controls these engine systems:

- Fuel
- Starting
- Ignition
- Compressor airflow
- Turbine case cooling.

Only one channel controls the engine at a given time. If one channel cannot maintain control, the EEC switches to the other channel.

The EEC uses thrust lever position, engine data, and airplane data to calculate the engine fuel flow and air system configuration.

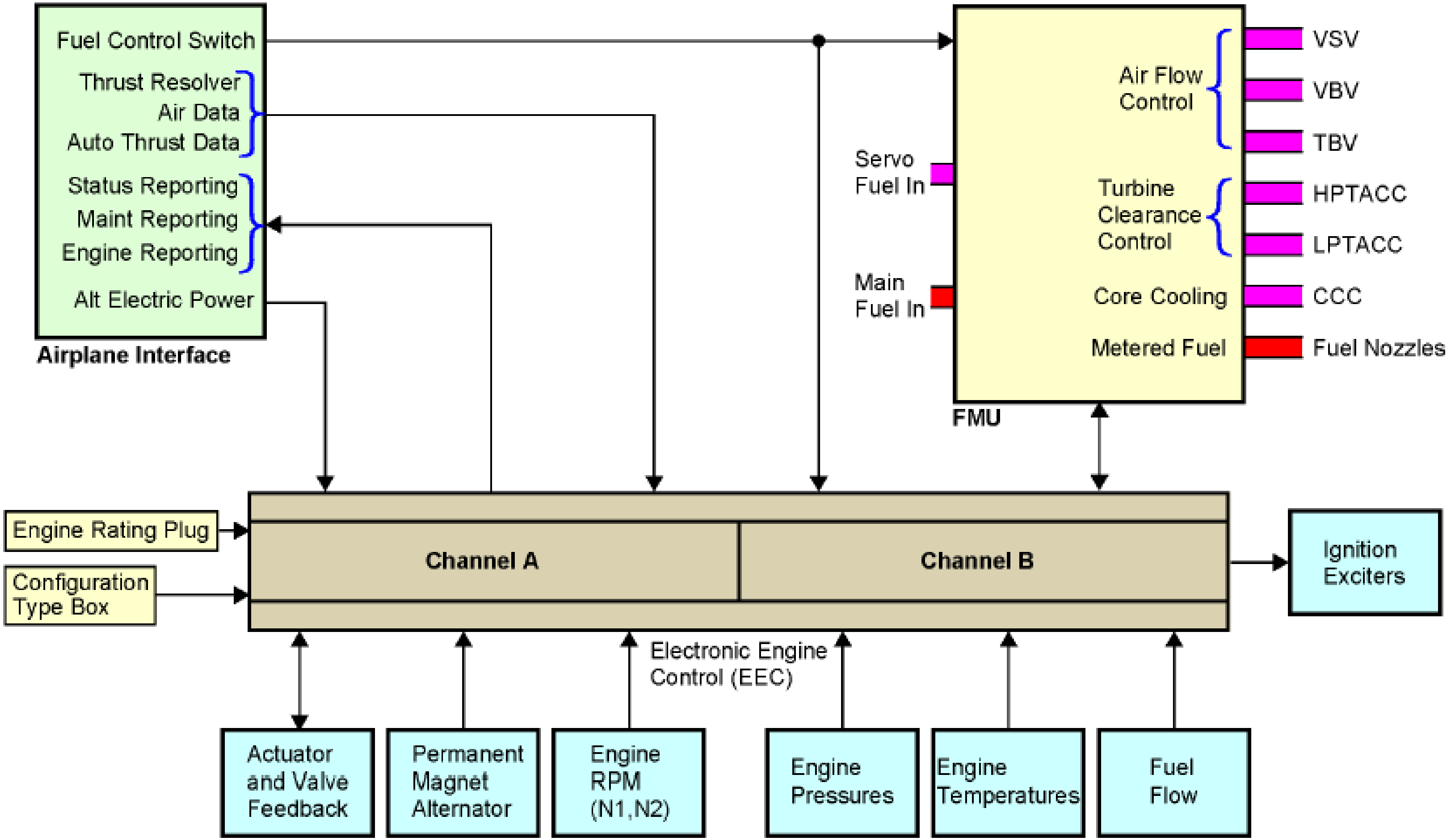
The EEC controls valves, servos, and actuators to achieve the commanded thrusts.

The engine-driven Permanent Magnet Alternator (PMA) supplies power to the EEC. The airplane electrical system supplies alternate power to the EEC.

Most engine control inputs come from airplane sources. Engine sensors supply engine status data to the EEC.

The engine rating plug supplies N1 thrust data to the EEC.

The engine configuration type box supplies engine serial number and hardware configuration data to the EEC.


Fuel Control Switch
Thrust Resolver
Air Data
Auto Thrust Data
Status Reporting
Maint Reporting
Engine Reporting
Alt Electric Power
Airplane Interface
Servo Fuel In
Main Fuel In
Air Flow Control
Turbine Clearance Control
Core Cooling
Metered Fuel
VSV
VBV
TBV
HPTACC
LPTACC
CCC
Fuel Nozzles
FMU
Engine Rating Plug
Configuration Type Box
Channel A
Channel B
Ignition Exciters
Electronic Engine Control (EEC)
Actuator and Valve Feedback
Permanent Magnet Alternator
Engine RPM (N1,N2)
Engine Pressures
Engine Temperatures
Fuel Flow

Engine Indications

The engine indication system supplies engine performance data to the Display Crew Alerting System (DCAS) in the Common Core System (CCS).

These are the primary engine parameters:

- Low Pressure (LP) shaft speed (N1)
- Exhaust Gas Temperature (EGT)
- High Pressure (HP) shaft speed (N2).

These are the secondary engine parameters:

- Fuel flow
- Oil pressure
- Oil temperature
- Oil quantity
- Engine vibration.

The Electronic Engine Control (EEC) sends the engine data to the DCAS through the Common Data Network (CDN).

Shaft Speed

The engine shaft speed system supplies N1 and N2 speed signals to the EEC. The N2 speed signal is also sent to the Engine Monitor Unit (EMU).

The Permanent Magnet Alternator (PMA) provides a backup N2 signal to the EEC. The EICAS display shows N1 and N2.

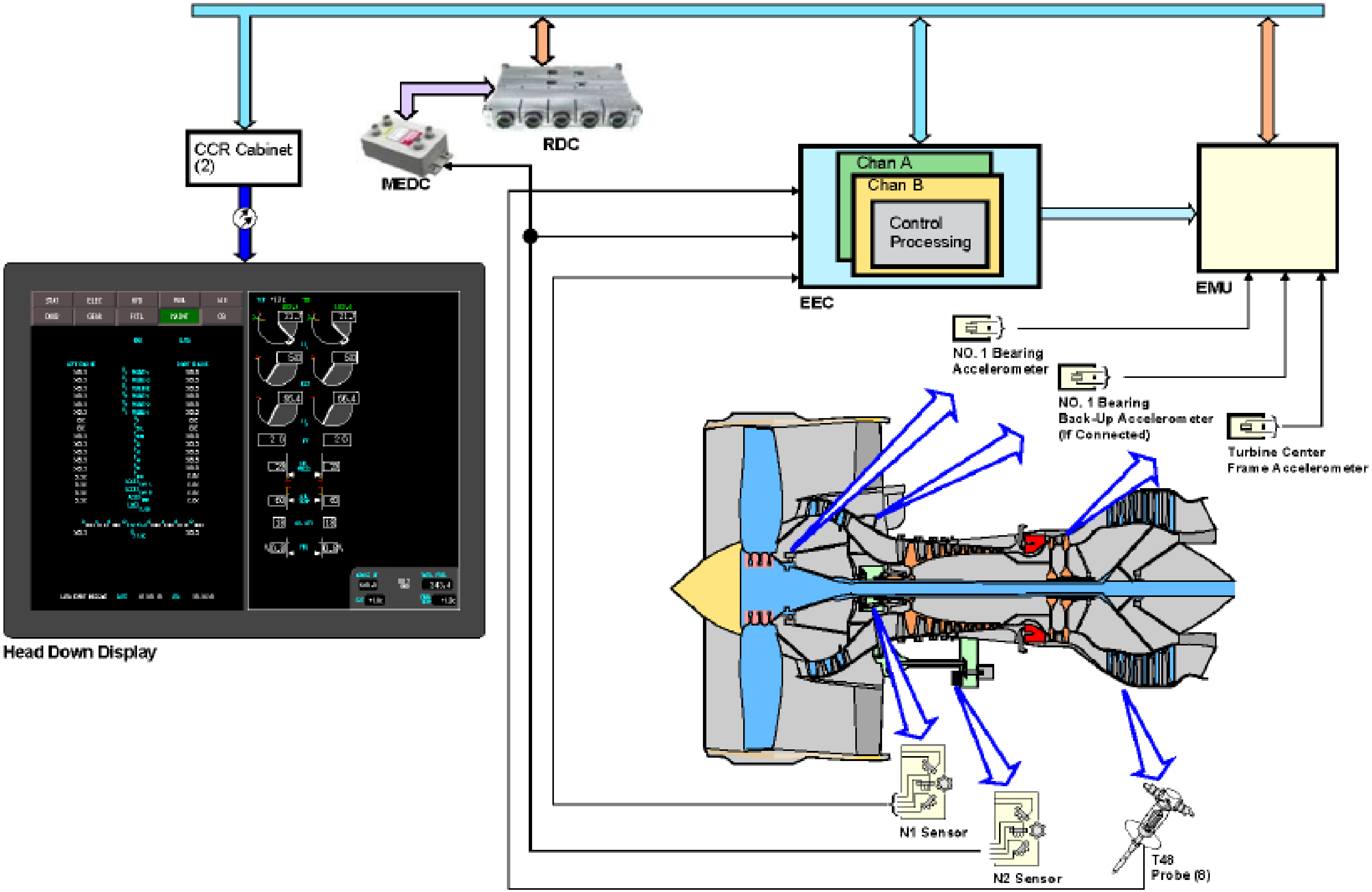
The EGT subsystem measures the temperature at the inlet to the LP turbine (engine station T48).

There are eight thermocouple probes. Each EEC channel processes four thermocouple input signals. The EICAS display shows the EGT.

AVM

The Airborne Vibration Monitor (AVM) system monitors engine vibration. Three accelerometers on each engine supply vibration signals to the EMU.

The EMU uses the signals and rotor speed signals to calculate vibration levels. The vibration appears on the secondary engine display.


CCR Cabinet (2)
RDC
MEDC
EEC
Chan A
Chan B
Control Processing
EMU
NO. 1 Bearing Accelerometer
NO. 1 Bearing Back-Up Accelerometer (If Connected)
Turbine Center Frame Accelerometer
Head Down Display
N1 Sensor
N2 Sensor
T48 Probe (8)

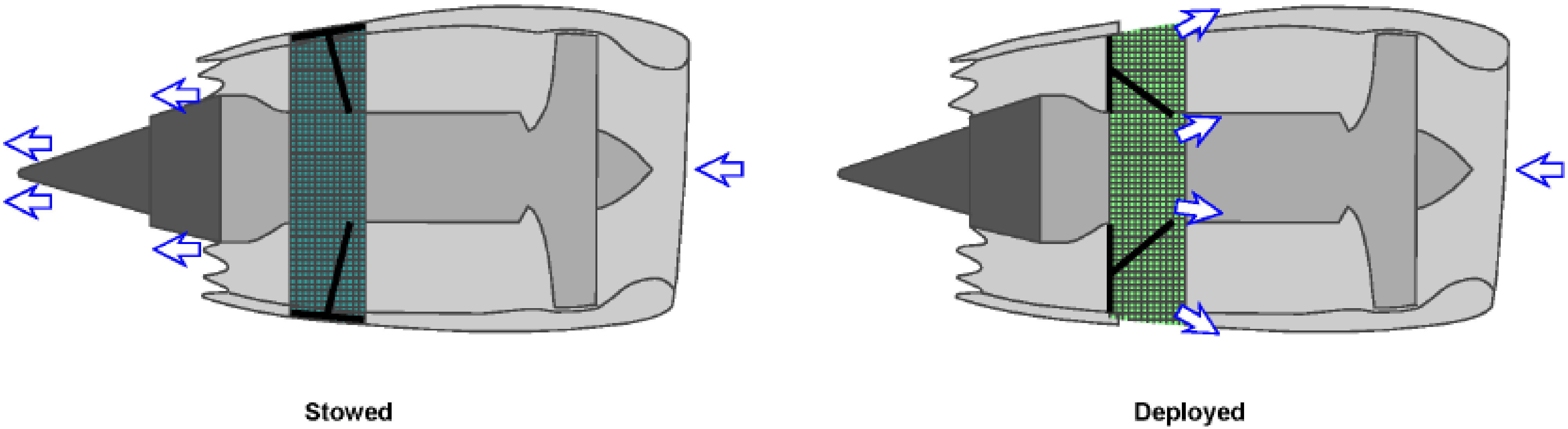
Thrust Reverser Operation

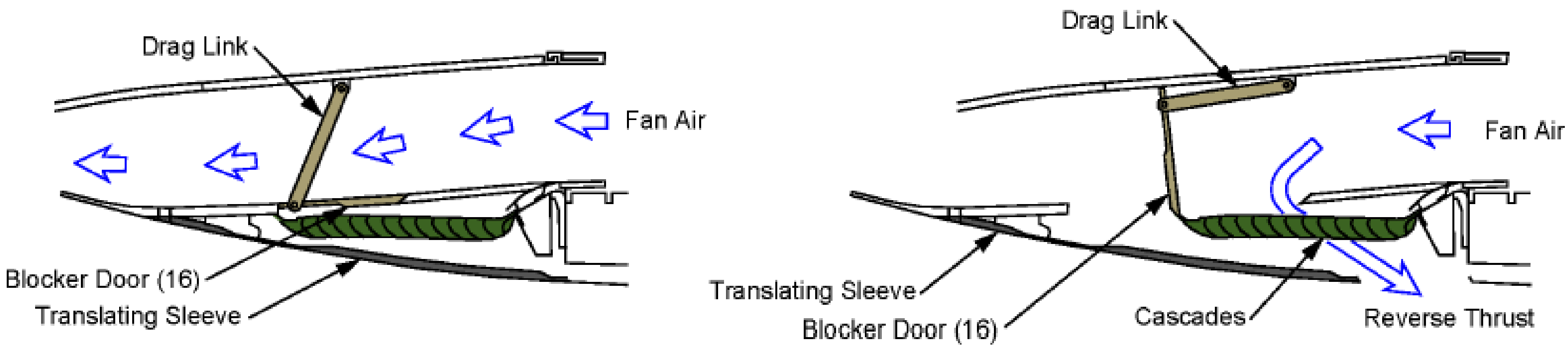
The Thrust Reversers (T/R) use electrical control and hydraulic power to operate on the ground only.

The T/Rs reverse only the fan stream air. When the reverse thrust levers are operated after landing, the two translating sleeves move aft. This causes the 16 blocker doors to close the fan duct and the fan air goes out radially and forward.

When the translating sleeves extend, these events occur:

- Cascades uncover
- Blocker doors deploy
- Blocked fan air goes out through the cascades
- Cascades direct the fan air forward.


Stowed
Deployed


Drag Link
Fan Air
Blocker Door (16)
Translating Sleeve
Drag Link
Fan Air
Translating Sleeve
Blocker Door (16)
Cascades
Reverse Thrust